LAKE HURON SUPPLY

Abundant Water

FOR

Southeast Michigan

DETROIT METRO WATER DEPT.
DECEMBER 1973

Developed for the

PEOPLE,

INDUSTRY

and

COMMERCE

of

Southeastern Michigan

Cover Photo:

Southeast Michigan Courtesy NASA-Earth Resources
Technology Satellite (ERTS) Project

ROMAN S. GRIBBS, Mayor

CITY OF DETROIT

General Manager's Message

Gerald J. Remus

Dedication of the Lake Huron Water Supply marks an historic event for the people of southeastern Michigan. The new supply, together with other construction and existing sources, will provide the fresh water needs for some 8,000,000 southeast Michigan residents beyond the year 2020. Using the regional approach in solving the area's water supply and water pollution problems, the Detroit Metro Water Department leads the nation in total water resources management.

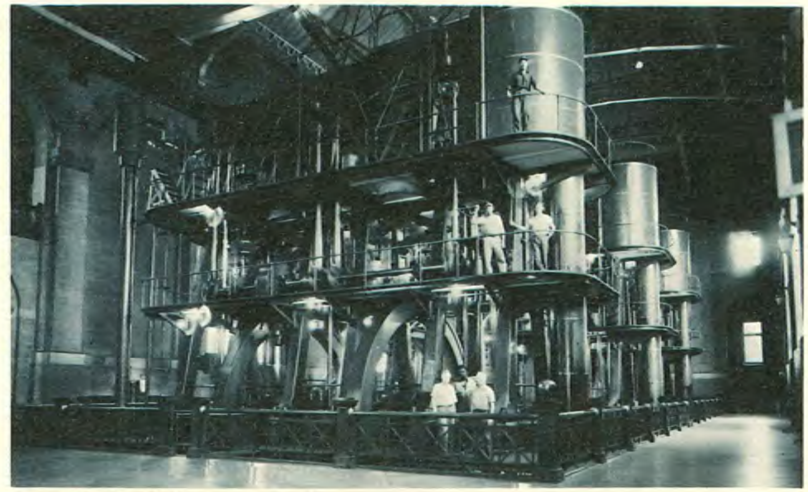
The $123 million Lake Huron Supply is the keystone of Detroit Metro Water Department's 1959 Water Development Program. Completion of the initial phase of the project is a result of teamwork, research and long range planning. Vital ingredients to its success were the far-sightedness of the Board of Water Commissioners in adopting the regional approach to the water supply problem; the cooperation of the various government agencies and communities during the planning and construction phase; and the devoted efforts of all the staff members who spent countless hours working from initial concepts to implementation.

Because of these efforts, the citizens of southeastern Michigan, for generations to come, will continue to enjoy a bountiful supply of highest quality fresh water in the nation at one of the lowest rates.

HISTORICAL REVIEW

1701 - 1954

DMWD's First Motorized Service Truck — 1917



Steam Engine Drive water pumps Retired from Service 1959

Early Times 1701-1853

The story of Detroit's water supply goes back to 1701, when the City was founded on the banks of the Detroit River. At that time, Detroiters obtained their water by dipping pails and casks into the river. This continued for about 120 years, until a pump was installed for the free use of the villagers. Shortly afterwards, exclusive rights were granted to a private company for supplying the City with water.

The company failed to provide adequate service for the City's ever increasing population. In 1836, after much bickering between the City and the company, the City purchased the water system and immediately began planning for a new and larger plant.

The Formative Years 1853-1905

On February 14, 1853, the State Legislature, on application of the City, amended the City Charter, creating a Board of Water Commissioners. The new Board promptly organized and immediatelygot to work on a new improvement and expansion program, and they have been at it ever since.

At the time the Commission was created, the total capacity of the system was 1 million gallons per day, (MGD). With the construction of the first stages of the Water Works Park Plant in 1879, and with later additions, this capacity was increased to 152 MGD by 1905. In 1900 the first adjoining suburb, River Rouge, was added to the system.

It is interesting to note that in 1895, a report was submitted to the Board of Water Commissioners on a proposed project to develop a 120 MGD Lake Huron water supply. This was the first official report considering Lake Huron as a source for supplying Detroit with water. The plan was not adopted for economic reasons.

The Expansion Era 1905-1954

Expansion of the system capacity started in 1909 with the addition of new facilities to the existing Water Works Park Plant.

Between the years 1911-24 several reports were submitted to the Board of Water Commissioners which considered Lake Huron and Lake St. Clair as a possible additional source of water supply. For reasons of economy it was decided to expand the City's water treatment facilities while continuing to use the river as the only source of water. This decision was followed by construction of the Springwells Plant, which was completed in 1931. The new plant and the Water Works Park expansion increased the system's capacity from 152 MGD to 735 MGD. Needless to say, as the City expanded, the system of transmission and distribution mains were also greatly expanded.

REGIONAL
1955

As the urban area continued to develop and grow, the per capita water consumption steadily increased. This increase eventually exceeded the water production capabilities of the existing system. Low pressures and inadequate supply were becoming routine during the summer months. Lawn sprinkling bans were initiated so that the more vital water needs of the community could be met. Immediate action was necessary to correct this and future problems, and in 1956 the Northeast Water Plant was placed into service. The new plant added another 240 MGD capacity to the system bringing the total to 975 MGD.

Under the leadership of Gerald J. Remus, the Detroit Metro Water Department accepted this challenge, and in 1959 the Board of Water Commissioners approved a report which outlined a water development plan for southeastern Michigan. The plan called for the Detroit Metro Water Department to deliver water as a wholesale supplier to each community individually or in groups. The communities, in turn, would construct and operate their own distribution system, and deliver water to the consumer on a retail basis. Included in the master plan was an agreement to purchase the water system developed by the Wayne County Road Commission together with the development of the Lake Huron Supply. A $35 million addition to the Springwells plant in 1959, together with the purchase of the Southwest Plant in 1964 increased the system capacity to 1300 MGD.

This new approach to solving the area's water problem required a considerable selling effort by the Detroit Metro Water Department. The Department had to reverse widely held opinions of many communities, government agencies and staff members that the system should not expand. Local suburban officials feared that a loss of local control over water supplies would expose them to outside political influences. Fears also existed that the quality of service to these communities would be second to Detroit. Doubts were expressed about the use of water revenues from the suburbs for the benefit of the City of Detroit, and about the financing capabilities of the Department for the huge amounts of money required for construction of the regional water facilities. Detroit officials were concerned about pledging the faith and credit of Detroit's Water System to finance construction of facilities which would directly benefit the suburbs. Detroit citizens were concerned that their tax money and funds from water revenues were being used for the benefit of the suburbs.

To dispel these fears and doubts, the master plan outlined the policies and procedure under which the expansion would proceed. The City of Detroit Charter gives the Detroit Metro Water Department the legal right to provide service outside Detroit. It also prohibits the mixing of water or sewage revenues with each other or general City tax funds. These funds can only be used to maintain, operate and expand the system from which they were derived. No local tax money is used in any financing by the Department. Furthermore, the financing, administration and construction of the water system are handled on a true utility basis. Expansion is financed by the sale of revenue bonds. A City of Detroit ordinance authorizes sale of

Construction of 120" water line from Lake Huron Plant to Imlay Station

SUPPLY
1973

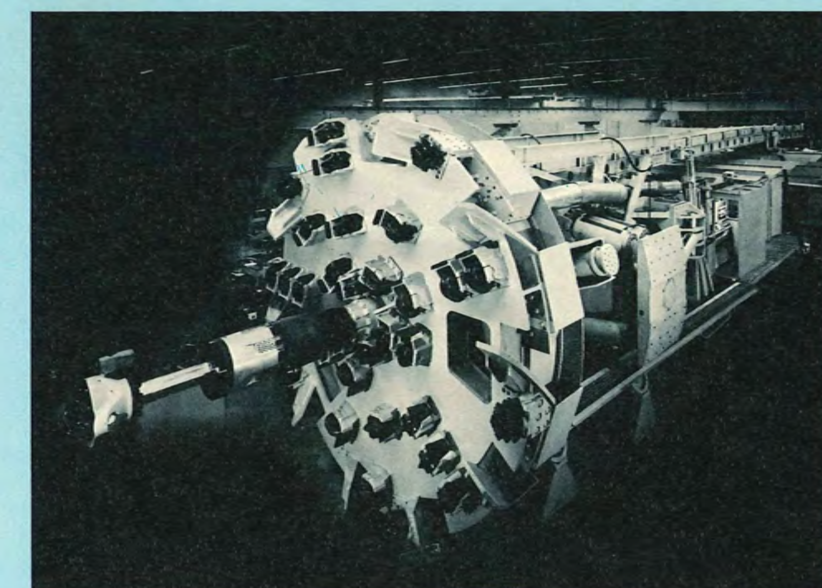
bonds and permits this sale only if net operating revenues of the last completed operating year is sufficient to provide 150% of the largest requirement for principal and interest due in any future year. This requirement together with the large equity in existing facilities have made Detroit Metro Water Department's bond rating Aa. A result is low interest rates for financing new expansion.

To provide for system integrity, long term contracts were entered into with each of the suburban communities served. These contracts require that construction of suburban owned distribution systems be in accordance with strict standards established by the Department. To provide for financial integrity, the contracts contain minimum bill provisions. This insures that the Department will acquire additional revenues as the suburban areas continue to grow.

The contracts also set the criteria for establishing water rates. The Board sets the water rates to cover the cost of service. To insure safeguards in rate setting and other Department operations, the Board of Water Commissioners was expanded from four to seven members in 1960. These three additional members represent suburban interests and gives the suburbs a voice in Department operations, this is provided for in the City Charter.

All these provisions result in lower rates for everyone in the system. Detroiters enjoy a lower water rate than if they were to go it alone. They are the owners of the system and receive at rate of return just as utility stockholders do.

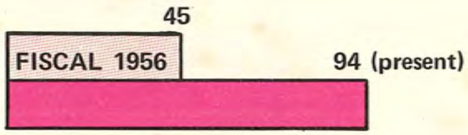
Intake Crib



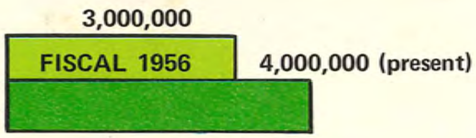
Mechanical Tunneling Machine, used to excavate Lake Huron tunnel

SYSTEM GROWTH 1955-73

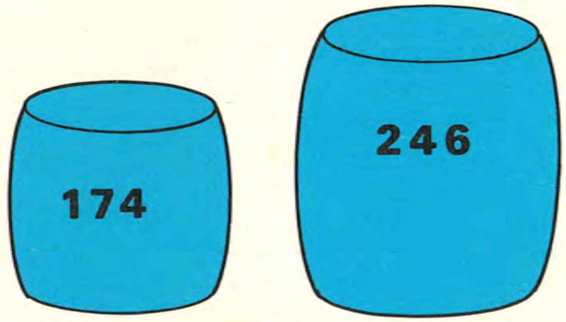
COMMUNITIES SERVED



POPULATION SERVED



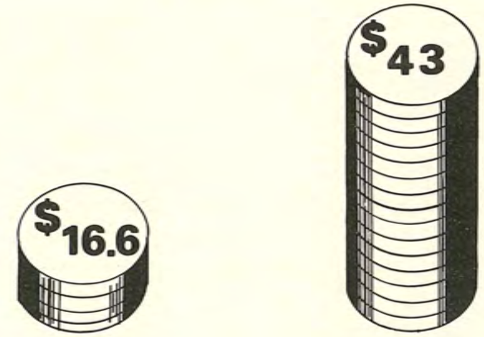
PUMPAGE



BILLION GALLONS PER YEAR

1955-56 1972-73

OPERATING REVENUE



MILLION 1955-56

MILLION 1972-73

ASSETS

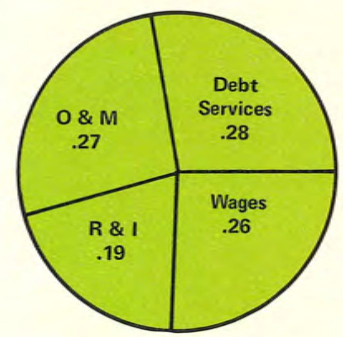
(PLANT, PROPERTY AND EQUIPMENT)

$199 MILLION 1955-56

$559 MILLION 1972-73

DISTRIBUTION OF THE REVENUE DOLLAR

1955-56

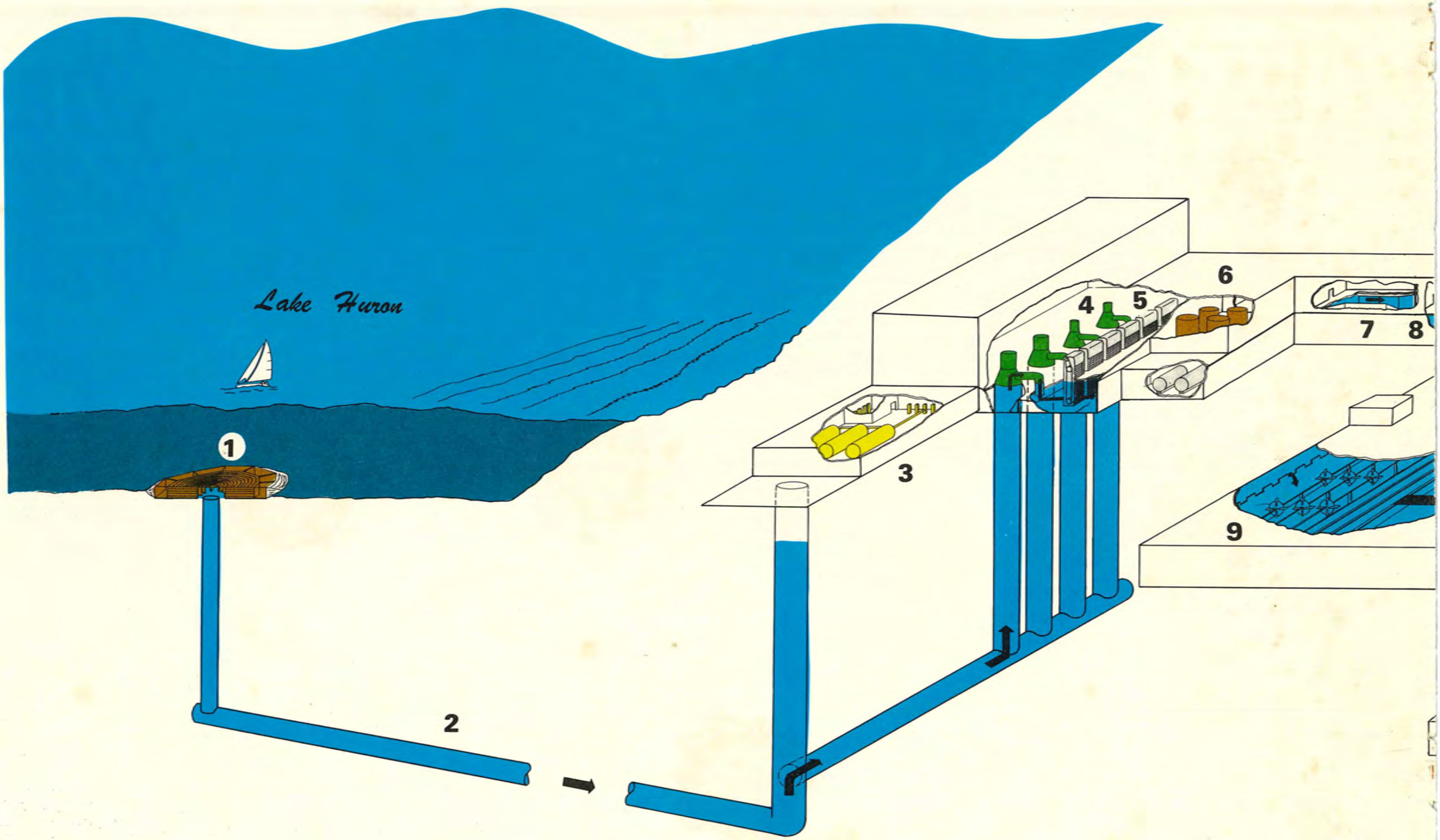


1972-73

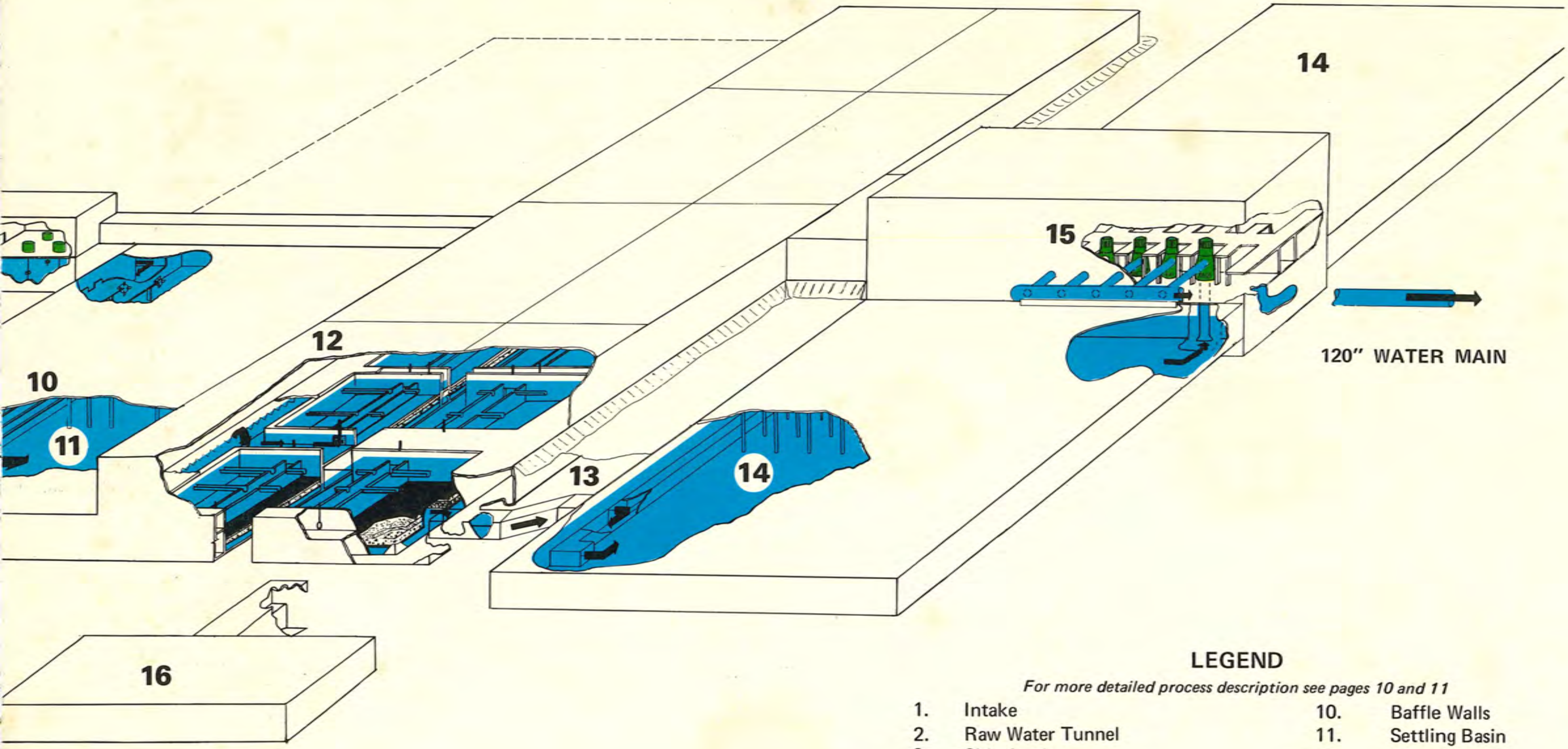
O & M = Operation & Maintenance
R & I = Replacements & Improvements

Caption: Left — Lake Huron Water Treatment Plant

LAKE HURON WATER



TREATMENT PLANT

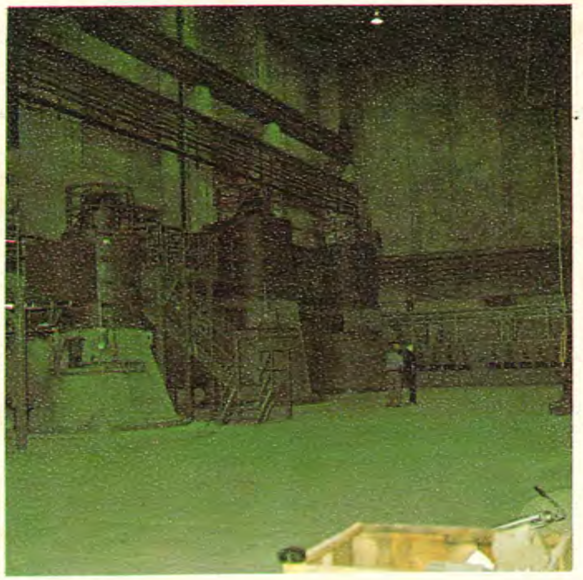


LEGEND

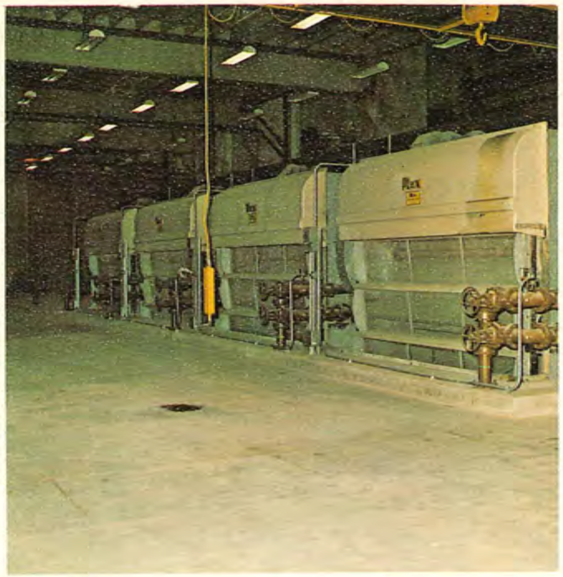
For more detailed process description see pages 10 and 11

1. Intake
2. Raw Water Tunnel
3. Chlorination
4. Low Lift Pumps
5. Screening
6. Chemical Storage
7. Venturi Meter
8. Chemical Mixing
9. High Energy Flocculation
10. Baffle Walls
11. Settling Basin
12. Filtration
13. Post Chlorination
14. Suction Wells
15. High Lift Pumping
16. Administration, Laboratory and Control Building

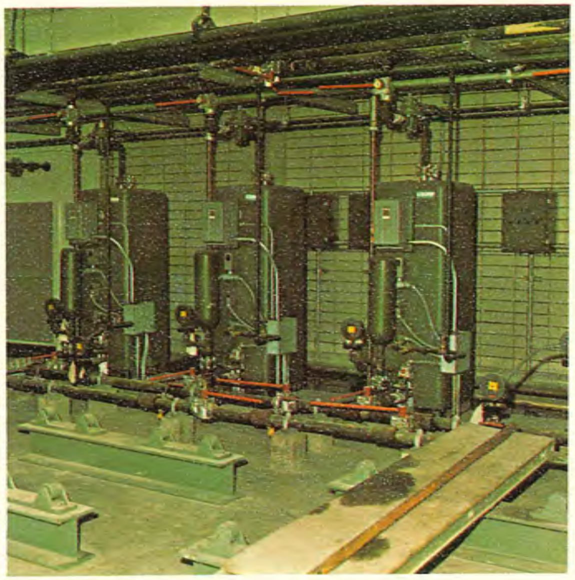
HOW DETROIT'S



Low Lift Pumps



Screens



Chemical Feed Units

There are three main steps in Lake Huron water treatment which take place before the water is used by the consumer.

They are:

* Transporting untreated (raw) water from its source to the filtration plant.
* Treating the water by removing such impurities as dirt, odors and bacteria.
* Transporting clean, germ-free water from the Lake Huron plant to the Metropolitan Detroit area where it can be distributed to the consumer.

Intake and Tunnel – Raw water from Lake Huron enters the system through a submerged intake crib. The crib is located 5-miles offshore and rests on the lake bottom in 45-feet of water. After passing through the intake the water travels by gravity through the tunnel to the low-lift plant. The tunnel is below the lake bottom, approximately 190 feet below the water surface.

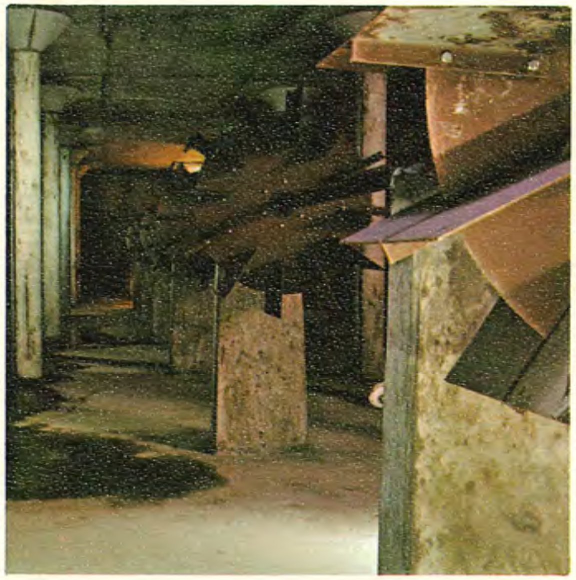
Low Lift Pumping – Four huge pumps with a total daily capacity of 600 million gallons lifts the raw water from the intake tunnel, a vertical distance of 53-feet, so that it will flow by gravity through the treatment process. Additional pumps will be added, when required, to raise the rated capacity to 1200 million gallons per day.

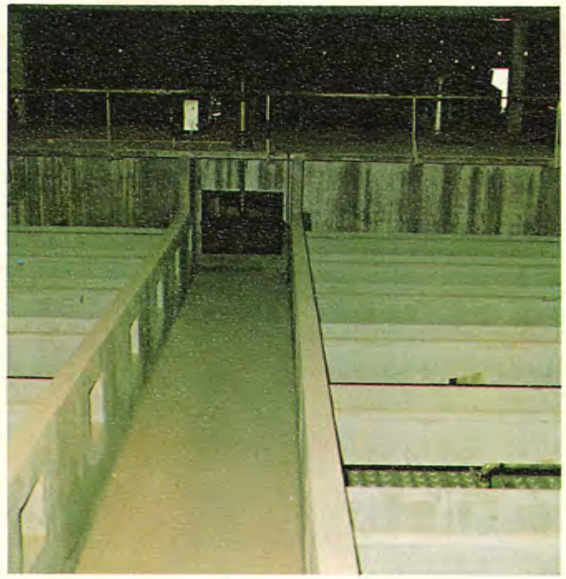
Screening – The low-lift pumps discharge the raw water into the screen room where it passes through screens which remove the large bits of debris and objects such as sticks and fish.

Chemical Addition and Mixing – The water now passes through the rapid mixers where chemicals such as filter alum, activated charcoal, chlorine

Right: Aerial View Lake Huron Plant Construction

WATER IS TREATED


Flocculators


Filter Beds


V-notched Weirs

and fluoride are added according to highly controlled standards. Automatic measuring devices, under supervision of highly trained and licensed chemists, feed these chemicals into the water ahead of the rapid mixtures. This mixture is violently agitated.

Flocculation – The water then enters the flocculation basins where flocculators – mixers which resemble the paddle wheel of an old-time riverboat – slowly stirs the water. This hastens the chemical process that causes the suspended impurities to be attracted by the alum, forming large particles called "floc."

Settling Basins – The water containing floc flows through the settling basin where the floc sinks to the bottom of the basin. Periodically the settling basins are drained and the accumulated floc, called sludge, is flushed into a drain. The water is now ready for filtering.

Filtration – The final cleansing of the water takes place in the filter building. A filter bed is like a big open-topped concrete box filled with gravel, sand and anthrafilt (coal). As the water percolates through the filter media all remaining impurities are removed. Filter beds must be washed regularly. By reversing the flow, water is forced up through the filter media and the impurities which were deposited during filtration are floated away.

Suction Wells – As the water leaves the filters more chlorine is added to insure purity. The water flows into suction wells which have a capacity of 15 million gallons each. Here the chlorine is allowed ample time to disinfect any remaining bacteria before it is pumped into the system and delivered to the customer. The suction well also acts as a surge chamber in case of a sudden shut down of the high lift pumps.

High Lift Pump Station – Powerful high lift pumps suck the potable water from the suction wells and push the water under pressure through the 120-inch water transmission main for its trip to the consumer.

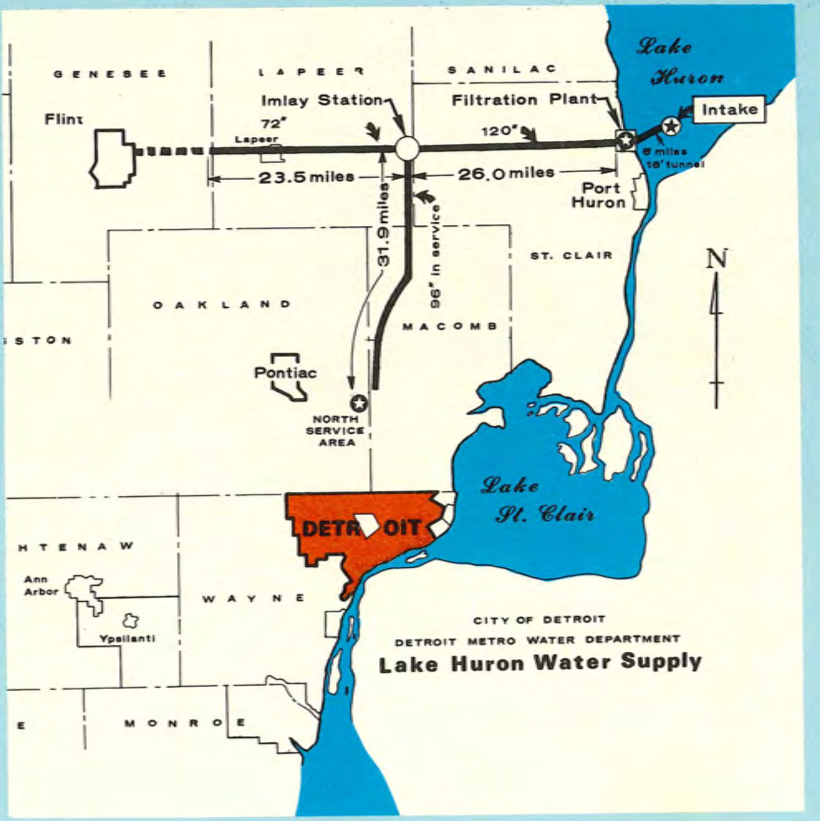
ELEMENTS OF THE LAKE

The Detroit Metro Water Department's water development program (see map inside back cover) is a result of the growing demand for treated water in southeastern Michigan. Projections indicate a tremendous amount of water service will be required by the year 2020; nearly twice that presently available. To provide for this demand the Department undertook development of the Lake Huron Water Supply.

Water quality, economics and an alternate source were the primary factors which led to the decision to turn to Lake Huron as a source of supply. Tests taken on Lake Huron water showed that its bacteria and pollutant content were very low, thus providing lower production costs.

Civil defense and security agencies have continuously encouraged the Board to provide water from another source remotely located from the present intakes in the Detroit River, in order to provide a partial supply in case of failure of the present intakes. These recommendations are now a reality, with the Lake Huron source.

The City of Flint also studied the problem of obtaining an economical water supply from Lake Huron. As early as 1959, exploratory talks were held with Flint with a view of combining efforts in the development of a Lake Huron Supply, to avoid duplication and to realize greater economy for both interests. In June 1964, a water service contract was signed with the City of Flint to include them in the regional system. This agreement was the major influence in determining the physical make-up of the first phase of the project. Water service to Flint commenced in December 1967. The source of supply for this service was the Detroit River, and water is delivered through the newly constructed 96-inch and 72-inch mains, which are part of the Lake Huron Supply. The flow in these supply mains will now be reversed to provide Lake Huron water to both Detroit and Flint.

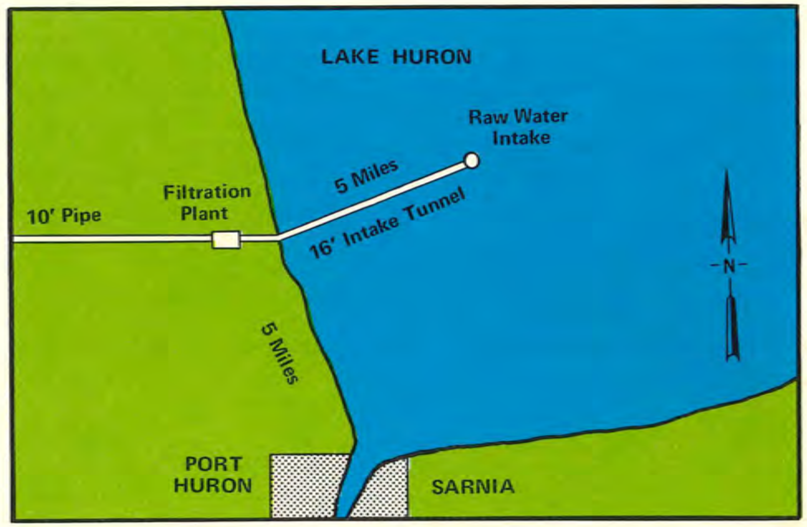


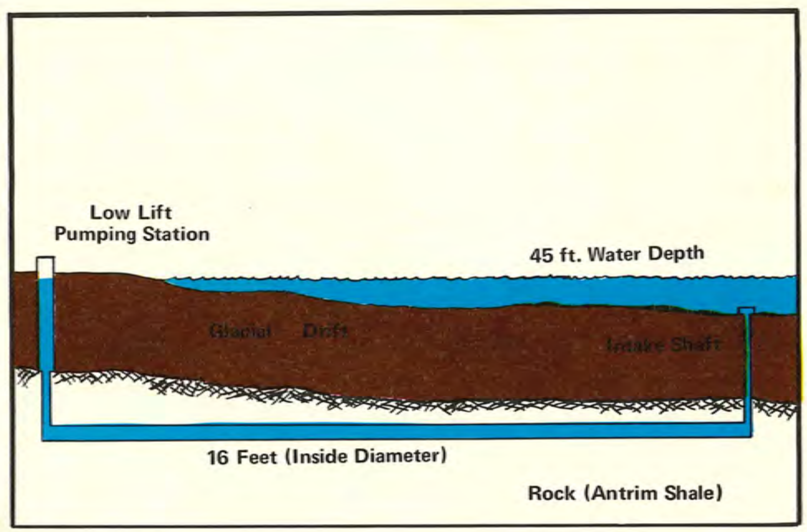
HURON WATER SUPPLY

Construction of the $123 million Lake Huron Water Supply, together with other improvements and new construction in Detroit and the surrounding metropolitan area insures a reliable and abundant source of high quality, low cost water for present and future users into the 21st century. The project was designed so that segments could be added to the system as water requirements dictate. The plant is designed so that additional capacity can be provided without any major construction. Additional transmission lines will be constructed on routes best suited to meet future needs. The raw water intake and tunnel are designed and constructed to provide for an ultimate capacity of 1200 (MGD) million gallons per day. Added to existing capacities a total ultimate capacity of 2500 MGD will be able to serve 8,000,000 people beyond the year 2020.

Phase I of the water treatment plant will have a capacity of 400 MGD and will help provide for this area's needs until 1980 (added to the existing system). Construction costs for the various elements of Phase I of the Lake Huron Supply are as follows:

Raw Water Intake and Tunnel	$22 million
Water Treatment Plant	$36 million
Imlay Repumping Stations & Reservoirs	$ 6 million
Transmission Lines	
120" diameter – 26 miles	$28 million
96" diameter – 32 miles	$20 million
72" diameter – 23½ miles	$11 million
Total	$123 million





CONSTRUCTION

Much of the Lake Huron Water Supply was constructed using conventional building methods. However, construction of the raw water intake and tunnel did employ several unique and seldom used techniques. Because of the complexities, the intake and tunnel were expected to require the longest construction time. Initial construction on this segment was begun in 1968 and it was one of the last completed prior to plant start up.

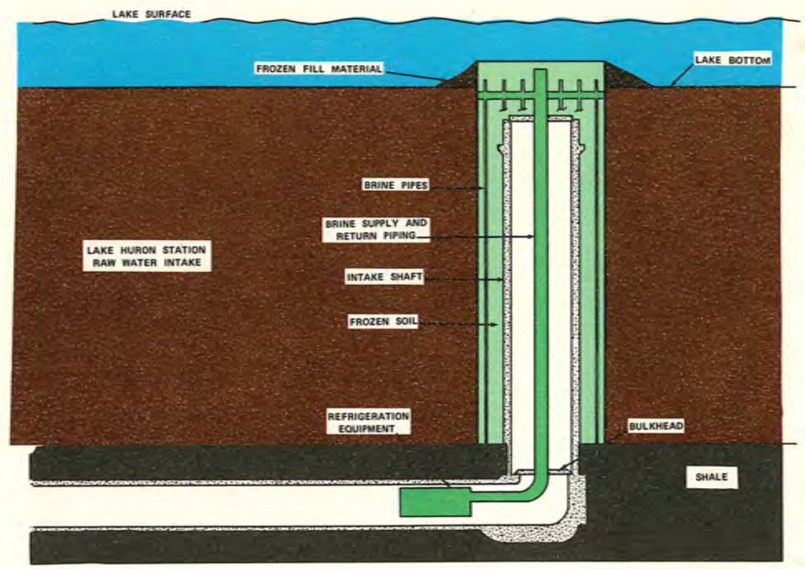
Construction of the 6-mile long tunnel was accomplished by means of a mechanical "mole." The mole carved an 18-ft. diameter tunnel in bedrock (antrim shale) at an average speed of 150 feet per day. After it was done, more than 310,000 cubic yards of rock, weighing 1.2 billion pounds had been excavated. Tunneling began at the shore shaft, one mile inland from the lake, and proceeded toward the lake shaft, located five miles off shore.

The intake crib is of the submerged type. It is constructed of timber and is similar to other successfully built and operating lake cribs, except it is the largest of its kind. The crib structure was built on shore at Cheboygan, Michigan. It was floated down to the intake site where it was sunk to its final position over the lake shaft.

The lake shaft was originally scheduled to be built using cellular cofferdams. This would permit excavation of the shaft from the top side. This scheme was abandoned after several attempts at constructing the cofferdam failed because of lake storms. The method finally used called for the shaft excavation to be completed from the tunnel. It involved a sophisticated method for freezing the soil and consisted of the following steps: (see adjacent illustration).

1. Install refrigeration equipment and freeze pipes
2. Place fill material over shaft
3. Freeze adjacent soil by pumping brine sollution through freeze pipes
4. Excavate the shaft from the tunnel
5. Place shaft lining and remove all equipment from tunnel
6. Excavate fill placed in step 2
7. Flood tunnel using ports in the cap
8. Sink intake crib over shaft

Construction of the system of transmission mains was comparable to building a miniature subway system 82 miles long. A combined total of 23,000 sections of 120", 96" and 72" diameter pipe were used in the construction. Each section of the 120" diameter pipe weighed approximately 35 tons – the largest ever used in Michigan – and is large enough for a standard size bus to pass through. The majority of the pipe lines were constructed in easements instead of road rights-of-way, thereby eliminating much inconvenience to motorists and the general public.



Lake shaft excavation procedure

FACTS ABOUT THE LAKE HURON WATER SUPPLY

LAKE HURON WATER TREATMENT PLANT

RATED PLANT CAPACITY – GALLONS PER DAY	
Initial	**400,000,000**
Ultimate	**1,200,000,000**
AREA OF PLANT SITE – ACRES	**450**
COST OF INTAKE, TUNNEL, PLANT, EQUIPMENT & SITE	**$58,000,000**

RAW WATER INTAKE CRIB

12-sided timber structure, 150-ft. (across flats) by 16½-ft. high, rated capacity . . . . 1,200 MGD

RAW WATER TUNNEL

Length of tunnel	6 Miles
Size of tunnel – inside diameter	16 Feet
Tunnel lining thickness – monolithic concrete	2 Feet
Rated capacity	1,200 MGD

LOW LIFT PUMPING STA. & CHEMICAL BLDG.

Shore shaft – inside diameter . . . . 20 Feet

Each pump set in 10-ft. diameter caissons extending from station floor to 2-rock tunnels 16-ft. in diameter which are connected to the shore shaft

PUMPS:

Initial: 2 turbine type @ 100 MGD . 200 MGD
2 turbine type @ 200 MGD . 400 MGD

CHEMICAL FEED:

Carbon

Estimated consumption . . 3 lbs/MG
Initial storage . . . . . . 77,800 lbs.
Capacity – 65 days @ 400 MGD

Alum

Estimated consumption . . 65 lbs/MG
Initial storage . . . . . . 1,250,000 lbs.
Capacity – 48 days @ 400 MGD

Hydrofluosilicic Acid

1 ppm for all feed conditions . 8.35 lbs/MG
Initial storage . . . . . . 96,800 lbs.
Capacity – 29 days @ 400 MGD

Chlorine

Pre-chlorine, estimated consumption 1.2ppm
Post-chlorine, estimated consumption . . 0.12ppm
Initial storage . . . . 87 tons
Capacity – 40 days @ 400 MGD

FLOCCULATION BASINS (4 ultimate)

Initial – 2 covered reinforced concrete structures each 170-ft. by 145-ft. by 18½-ft. high
Adjustable speed paddle type mixers
10 flocculator drive motors per basin

SETTLING BASINS (4 ultimate)

Initial – 2 covered reinforced concrete structures each 651-ft. by 153-ft. by 18½-ft. high

FILTER BUILDING

Initial – 40 dual media filters rated @ 10 MGD each
Size 60-ft. by 47-ft.
Media 18" Anthrafilt
7" Sand
14" Gravel
Surface Wash – ½ to ¾gal/min/ft^2
Wash Water 40,000 gal/min @ 24" rise

SUCTION WELLS

2 suction wells @ 15 MG each, 370-ft. by 264-ft. by 15-ft. deep each

HIGH LIFT PUMPING STATION

Pumps:

Initial: 7 turbine type line pumps @ 60 MGD
4 washer pumps @ 50 MGD

IMLAY REPUMPING STATION

PUMPS: 2 Horizontal Centrifical Variable Speed @ 60 MGD
1 Horizontal Centrifical Fixed Speed @ 60 MGD

RESERVOIRS: Capacity – 20 MG

AREA OF PLANT SITE: 36 Acres

TRANSMISSION LINES

SIZE (INSIDE DIAMETER)	MILES	SECTIONS OF PIPE LAID	WT/SECTION – TONS
120-inch	26	8,600	35
96-inch	31.9	8,500	28
72-inch	23.5	6,200	17

PLANNER, DESIGNERS AND BUILDERS

PAST OFFICIALS

Mayor

Jerome P. Cavanagh (1967-69)

Common Council

Mary V. Beck (1956-66)
James H. Brickley (1962-66)
Edward Carey (1958-66)
Edward Conner (1958-66)
Louis Miriani (1966-70)
Robert T. Tindal (1968-71)
Anthony Wierzbicki (1968-73)

DMWD Commissioners

Julius Allen (1962-69)
George Fulkerson (1962-72)
Henry Kozak (1968-72)
John H. McCarthy (1964-69)

Consultants

Alvord, Burdick & Howson
Singstad, Kehard, November & Huka
Smith, Hinchman and Grylls
Ayres, Lewis, Norris & May

Contractors & Equipment Supplies

Allis Chalmers
Bass Construction Co.
Butler Construction Co.
Byron-Jackson Pump
Div. Borg Warner Corp.
Capital Dredge & Dock Corp.
Cates Electric Co.
Corey & Hartwig & Co., Inc.
A. J. Etkin Construction Co.
Federal Pacific Electric
Rocco Ferrera & Co.
Greenfield Associates
Golcheff Brothers Excavating Co.
Indian River Construction Co.
Johnston Pump Co.
Mile High Drilling Co.
F. H. Martin Construction Co.
J. Marcelletti Excavating Co., Inc.
Oakland Electric
Portland Construction Co.
Shaw Electric
Vito Trucking & Excavating Inc.
Weissman Construction Co.

DMWD STAFF

Administration

G. Remus
John Fahner
Earl Ellenbrook
Ernest Cedroni
George Dehem
D. Suhre
Ronald Bekkala
Adolph Ploehn
Erman Fisher
Albert Shannon

Technical Supervisors

C. "Bud" Schultz
Edward Johnson
Robert Cinder
Eugene Bonadeo
William Herrscher

Harriett Abramsen
Louis Becker
John Bischak
Nancy Branston
Wesley Callfas
James Carethers
William Carney
George Cascas
Dave Casey
Charles Chapin
Joseph Costa
Frank Daskus
Julius Davis
Ken Day
Thomas DeRiemaker
Michael Dodyk
Edward Everett
Douglas Fletcher
William Gleeson
David Greenidge
Joseph Grunas
Larry Harlow
Neal N. Hoaglund
Fred Janeczko
Denise Jones
Anne Kaiser
Edmund Karsten
Joseph Kelly
Leonard Keusch
Vernon Kokko
Charles Kropf
Henry Lane
Sherman Langell
Julius Lewandowski
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Karl Poth
Charles Powell
Theodore Ragland
Harry Rahn
Robert Roof
John Rucker
Edward Rutkowski
Irving Schuraytz
Girish Shah
George Sobak
Thomas Standen
Raghuvir Talwalker
Vaughn VanKemp
Donald Wiedyke
Gary Wilson
Willie Wilson
Thomas Wojno
Robert Wright
William Zarkis
H. Bartling, Ret.
Harold Britz, Ret.
Morris Deo, Ret.
Francis F. McCormick, Ret.
A. C. Michael, Ret.
Gilbert Olsen, Ret.
Emmanuel Ravetta, Ret.
Agostino Reale, Ret.
Robert Steventon, Ret.
David Tulip, Res.
Keith Uutinen, Res.
Harvey Werner, Res.
Robert Edmond, dec.
Byrd Finley, dec.

IN MEMORIUM

Manuel G. Abasta
Romualdo Alvarez
James Beesley
Roswell Brown
Raymond Comeau
Gerald Curtis
Patrick Dingman
Charles Epperson
Charles Epperson, Jr.
Donald A. Fogal
Ellis Grant
Donald D. Hardel
Kenneth Hawes
Martin Laretz
Frank E. Polk
Jimmy H. Reighard
Gary Roehm
Claybourne Simpkins
Guillermo Taran
Glen Verner
Donald L. Williams
Walter J. Wood
Vernard Woolstenhulme

METRO DETROIT WATER DEPT.

Supervision and Text — F. R. Janeczko / Art Design and Photography — C. Porter / Composing — A. Kaiser

Litho in U.S.A.